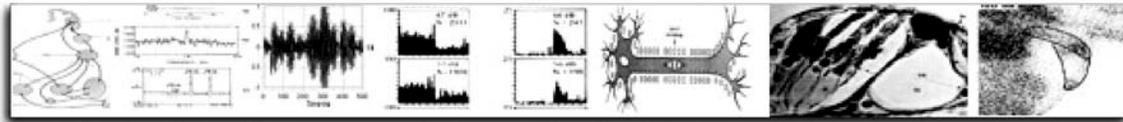


Psychoacoustics
Columbia College, Chicago
Spring 2015 – 43-2310 Section 05 – Pantelis N. Vassilakis Ph.D.
<http://www.acousticslab.org/psychoacoustics>



Course # / Section	43-2310 / 05
Credits	3 hours
Class time / place	Thursday, 12:30-3:20 p.m. / 33 E. Congress Ave., Room 609
Course Site	http://www.acousticslab.org/psychoacoustics
Instructor	Pantelis N. Vassilakis, Ph.D.
Phone	Cell: 773-750-4874 – Department: 312-369-8820
e-mail	pvassilakis@colum.edu (preferred mode of communication)
Web	http://www.acousticslab.org
Office hours	By appointment
Pre-requisites	43-2725 “Studies in Hearing”

COURSE INTRODUCTION

Psychoacoustics is a multidisciplinary field that examines the relationship between the physical world of acoustics and the perceptual world of hearing. More specifically, it examines ways in which physics and physiology interact to give rise to sound sensations/perceptions. An understanding of psychoacoustics is essential to those wishing to pursue a career in any discipline that involves sound.

COURSE DESCRIPTION

Class provides the necessary basis for understanding how we hear the world around us. The course is multidisciplinary, with contributions from the academic disciplines of auditory physiology, physics, and psychology. It examines how the human auditory system processes the information it receives, that is, how physical attributes of sound translate into perceptual attributes such as loudness, pitch, and timbre. Topics extend to the perception of music, sound localization, speech, and beyond. Numerous audio-visual demonstrations are used to reinforce the theoretical material presented.

COURSE RATIONALE AND PREREQUISITES

Auditory perception, i.e., hearing, is subjective, while most measurements in acoustics are objective. It is therefore necessary to discriminate between subjective and objective sonic quantities and explore how they relate. For instance, although a sound level meter might display the same reading for two acoustical signals, listeners might hear one of them is much louder than the other. Moreover, listeners usually demonstrate individual differences for a subjective quantity. A good example is sound localization in the sagittal (e.g. median) plane: when presenting identical acoustical signal to two listeners through in-ear phones, one listener might localize it in the front, while the other might localize it in the back. The relationship between objective measurement and subjective perception is addressed by psychophysics, through observation and experiments, with psychoacoustics focusing specifically on auditory perception.

This course is intended for students who plan to pursue a career in acoustics, recording, audio arts, sound contracting, sound reinforcement, loudspeaker design, multimedia authoring, music, and other related fields. It fulfills a requirement for all AA&A majors at *Columbia College Chicago*,

LEARNING OUTCOMES

Upon successful completion of the course, students will have demonstrated:

- command of the basic perceptual attributes of auditory sensation and their physical/physiological correlates in terms of
 - pitch
 - loudness
 - timbre
 - sensory consonance/dissonance
 - sound-source localization
 - perception of sound environments
- ability to link subjective concepts of sound perception to objective quantities in acoustics and hearing physiology, supported by relevant audio demonstrations and illustrations of psychoacoustic phenomena.
- awareness of the behavioral and research methods used to study psychoacoustic phenomena, and an appreciation of the challenges in such study and research.
- understanding of audio applications of psychoacoustics, especially in the context of their own major/concentration within the Audio Arts & Acoustics Department.
- ability to report on research related to a specific topic in psychoacoustics.

TEXT AND MATERIALS

REQUIRED TEXT (AVAILABLE AT THE COLLEGE BOOKSTORE)

Plack, C.J. (2014 2nd Ed.). *The Sense of Hearing*. New York, NY: Psychology Press/Taylor & Francis.

LECTURE NOTES

Vassilakis, P. (2010/15). *Introduction to Psychoacoustics and Sound Perception*. Online lecture notes. <http://www.acousticslab.org/psychoacoustics>

ADDITIONAL REFERENCE RESOURCES

Békésy, G. von (1960). *Experiments in Hearing*. New York: McGraw-Hill.

Campbell, M. and Greated, C. (1987). *The Musician's Guide to Acoustics*. Oxford: Oxford University Press.

Deutsch, D. (1995). "Musical Illusions and Paradoxes." Compact Disc. La Jolla, CA: Philomel Records, Inc. http://philomel.com/musical_illusions/oncd2.html

Deutsch, D. (ed.) (1999) (2nd edition). *The Psychology of Music*. San Diego: Academic Press.

Fastl, H. Zwicker, E. (2007) (3rd edition). *Psychoacoustics, Facts and Models*. Berlin, Germany: Springer Series in Information Sciences (includes psychoacoustic demonstrations CD).

Helmholtz, H.L.F. (1862/1877/1885) (2nd edition). *On the Sensations of Tone as a Physiological Basis for the Theory of Music*. Trans. A. J. Ellis. New York: Dover Publications, Inc. (1954).

Moore, B.C.J. (2004) (4th edition). *An Introduction to the Psychology of Hearing*. London, UK: Elsevier.

Yost, W. A. (2007) (5th edition). *Fundamentals of hearing: An introduction*. New York: Academic Press.

EVALUATION PROCEDURES & GRADING SCALE

HOMEWORK/QUIZZES/ACTIVITIES: 20%

In each class session a set of topics will be addressed and readings will be assigned (from the textbook and other supplied resources). Homework will be distributed after some of the classes to assess students' understanding of materials presented in class and in readings. In-class activities will also take place. Students are responsible for completing all in-class activities and homework as assigned and on time. Students who are absent are responsible for making arrangements to (a) turn in completed homework and (b) obtain and complete any materials distributed in class. In-class quizzes will also take place. The lowest two quizzes will be dropped from the overall quiz grade. In addition, the lowest homework grade will be dropped from your final grade calculation.

TESTS: 40% (2 TESTS, 20% EACH)

FINAL EXAM: 25%

Two in-class tests and a final in-class cumulative exam are scheduled, covering materials discussed in class, not all of which are included in the textbook.

RESEARCH PROJECT - 15% (25% ORAL PRESENTATION, 75% WRITTEN REPORT)]

Students will work in groups of 3-4 on a specific topic of their choice, within the area of sound perception. Group formation and topic selection are due between Weeks 8-10 of the semester. Project presentation and submission are due the week before the final exam. Detailed project instructions are provided in a separate document.

GRADING SCALE

90% ≤ A	74% ≤ C+ < 77%
87% ≤ A- < 90%	70% ≤ C < 74%
84% ≤ B+ < 87%	67% < C- < 70%
80% ≤ B < 84%	60% < D < 67%
77% ≤ B- < 80%	F < 60%

I: (incomplete – assigned in accordance with the College's academic guidelines)

STUDENTS WITH DISABILITIES STATEMENT

Columbia College Chicago seeks to maintain a supportive academic environment for students with disabilities. Students who self-identify as having a disability should present their documentation to the Services for Students with Disabilities (SSD) office. After the documentation has been reviewed by the SSD office, a Columbia College accommodation letter will be provided to the student. Students are encouraged to present their Columbia accommodation letters to each instructor at the beginning of the semester so that accommodations can be arranged in a timely manner by the College, the department, or the faculty member, as appropriate. Accommodations will begin at the time the letter is presented. Students with disabilities who do not have accommodation letters should visit the office of Services for Students with Disabilities, 623 S. Wabash Room 304, (312-369-8296)
<http://students.colum.edu/ssd>

CLASSROOM POLICIES

- You are expected to abide by the College's policies on **academic honesty and integrity**, <http://colum.edu/integrity>. Violations include but are not limited to: cheating, plagiarism, fabrication, falsification or sabotage of research data, destruction or misuse of the College's academic resources, and alteration or falsification of academic records. Note that, while using a variety of resources to help you complete your assignments is not only encouraged but expected, copying them verbatim fails to communicate whether or not you have understood the materials, constitutes plagiarism, and is penalized.
- **Be respectful of all class members. Be prepared to accept and offer criticism, to question and be questioned.** Intellectual disagreements and conflicts that do not involve personal attacks are strongly encouraged. They are necessary in order to formulate strong intellectual argumentation skills and improve understanding.
- Cell-phones and other mobile devices must be silent during class. **Be ready to begin by the scheduled class start time.**
- **Attendance** is necessary in order to do well in this course. **If you cannot make it to a class meeting you must notify me in advance via email or phone.** Unapproved, unexplained, and extensive absences will be penalized. Exceptional circumstances will be handled on an individual basis.

SATISFACTORY ACADEMIC PROGRESS

- In the fifth week of the semester, your teacher will be asked to provide some early feedback on your academic performance to help the College identify students who may be falling behind and are at risk of not satisfactorily completing a course. This online Academic Progress Report (APR) will notify students in time to seek academic coaching or other assistance to improve their grade. The APR is necessary because new federal regulations require students who achieve less than a 2.0 GPA and/or don't complete two-thirds of their classes for two semesters in a row to be dismissed from the College. Below is a sample, non-exhaustive list of indicators that may be considered by your teacher to trigger an early alert message regarding your progress:
 - Student has missed at least half of the scheduled class sessions or individual conferences (3 out of 5 for classes that meet once a week; 5 out of 10 for classes that meet twice a week).
 - Student consistently arrives more than 15 minutes late or leaves more than 15 minutes early and has turned in late the majority of assignments.
 - Student has earned a grade lower than C on the majority of graded assignments so far (including quizzes, homework, in-class activities, etc.).
 - If the semester ended at week 5, the student would receive a grade lower than C in this course.

STUDIO EQUIPMENT POLICIES & PROCEDURES

To manage requests for space and/or equipment utilization, the Department has developed a number of procedures applicable to both faculty and students. You can find the latest Policies/Procedures document and Equipment/Spaces Request form at <http://acousticlab.org/aaa/forms>. Adhering to these common-sense increases the likelihood that equipment and facilities will be available for the greatest number of students/faculty and over the longest possible life of the equipment. All students and faculty should be familiar with these policies and procedures.

COLLEGE-WIDE TUTORING

The Learning Studio, located at 618 S. Michigan Avenue, first floor, is an excellent resource for tutoring and Peer Academic Coaching in mathematics, science, English, foreign languages, technology, and more. To make an appointment click on the OASIS tab labeled "My Appointments," call 312-369-8130, or just walk in. For more information, please visit <http://www.colum.edu/learningstudio>

SUPPLEMENTAL INSTRUCTION STUDY GROUPS

Supplemental Instruction (SI) Peer Study Groups are available for Audio Arts & Acoustics students currently enrolled in this course

Please check <http://www.colum.edu/si> for SI Peer Study Group session days and times.

The goal of group SI sessions is to support student understanding of the information discussed in class. SI sessions are NOT a substitute for class attendance. Note that all students who take advantage of weekly SI sessions pass their classes, typically with a full letter grade higher than otherwise.

IMPORTANT DATES & TENTATIVE WEEKLY SCHEDULE

For deadlines on adding, dropping, or withdrawing from courses and for other important dates select the appropriate Semester at <http://www.colum.edu/academics/academic-calendar.html>
Specific weekly readings from the textbook and other resources will be assigned and lecture notes will be posted on the course's website by the weekend prior to each class session.

Module 01	Class introductions/expectations; Syllabus analysis <i>_Introduction to Psychophysics and Psychoacoustics: definitions and scope of study _Sound, Music, Noise: Essential & operational definitions _Basic physical variables and units (review)</i>
Module 02	<i>_Physical aspects of acoustic waves: _Basic acoustic concepts and measures _Logarithmic scales - Root mean square Pressure _Sound Waves - Inverse square law _Fourier analysis - Spectra - Amplitude and Frequency modulation _Resonance - Reflection/Reverberation - Diffraction - Refraction - Absorption - The Doppler effect _Linear Superposition & Interference _Musical instruments as sound-wave generators and transmitters _Signal Processing & Digital Signals</i>
Module 03	<i>_Biology of hearing; Nonlinearity of the hearing mechanism _Review of the auditory system _Nonlinear response to frequency and intensity _Masking and Psychophysical Tuning Curves</i>
(By Week 06)	Review for Test 1 - Test 1
Module 04	<i>_Perceptual attributes of acoustic waves – Part I: Loudness _Intensity discrimination & Just Noticeable Difference (JND) _Effects of frequency, spectrum, and duration; Loudness scales _Adaptation, Fatigue, & Temporary Threshold Shift (TTS)</i>
Module 05	<i>_Perceptual attributes of acoustic waves – Part II: Pitch _Definitions; Frequency/Pitch ranges; JND for pitch; Pitch of pure & complex tones; Pitch theories _Pitch relations/units; The Octave; Multidimensionality of pitch: Pitch height & pitch chroma</i>

Module 06	<ul style="list-style-type: none"> _ <i>Perceptual attributes of acoustic waves – Part III: Timbre</i> _ Cognitive aspects of timbre _ Beating & roughness - consonance / dissonance _ <i>Time and pitch, loudness, & timbre</i>
(By Week 10)	<p><i>Review for Test 2 - Test 2</i> (Group formation / topic selection for the research project are due)</p>
Module 07	<ul style="list-style-type: none"> _ <i>Auditory localization – Part I</i> _ Introduction _ Auditory localization cues: Interaural time (phase) and level differences _ <i>Auditory localization – Part II</i> _ Binaural cues and release from masking _ Sound source localization neural mechanisms _ Auditory localization cues: Interaural spectral differences & HRTFs _ Cone of confusion - Localization cues from head movements _ Judging sound source distance _ The <i>precedence</i> effect
Module 08	<ul style="list-style-type: none"> _ <i>Sound Environment</i> _ Introduction _ Perceptual criteria for room acoustics & related acoustic & room construction/layout features
(By Week 14)	<p><i>Research Project presentations</i> Research Project is due</p>
(By Week 15)	<p>Final Exam</p>

This schedule serves as an outline for the layout of the course. The instructor reserves the right to revise it depending on circumstances. Students will be informed of any changes in writing.